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User manual for ThermalCapture

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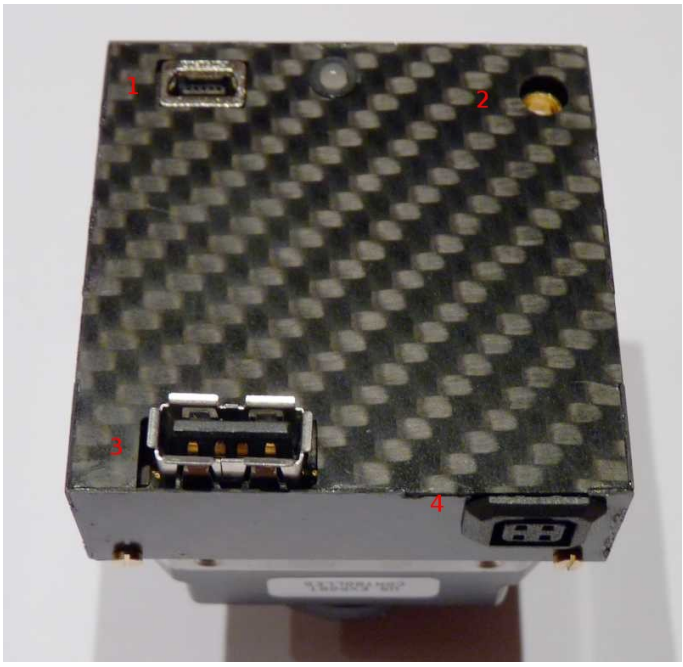
1 Initial Operation

Before you can use ThermalCapture the first time, it is necessary to proceed the following steps. This guide assumes that ThermalCapture is already mounted to a TAU core. If this is not the case please follow the *ThermalCapture Mounting Guide* first.

1.1 Wiring and Connectors

ThermalCapture has the following connectors:

1	Mini-USB for configuration and 5V Power Supply
2	Composite NTSC or PAL video out
3	USB for memory stick
4	Trigger and serial connector



1.1.1 Mini-USB Connector

ThermalCapture and the connected TAU core are powered from the Mini-USB interface. This interface also allows the configuration of the TAU core via the FLIR TAU GUI.
To do TAU core configuration disconnect any memory device from connector 3, connect ThermalCapture to your PC and follow the chapter 2 of this guide.

Thermal Capture is intended to be used with small UAVs. Therefore you need an adapter cable from Mini-USB to your 5V power supply. ThermalCapture can work with a DC voltage from 5 to 6V.

The source must be able to deliver at least 600mA continuous and peeks up to 1A.

1.1.2 Video Connector

This is a MCX connector, providing the NTSC or PAL composite video out from the TAU core. The video standard and other video related settings can be configured with FLIR TAU GUI, see chapter 2.

1.1.3 USB Interface for Memory Stick

This is a USB host interface, which is intended to be used with a small USB memory stick. It is able to power common memory sticks, but not USB hard-drives. ThermalCapture stores the captured images on the memory connected to this interface.

1.1.4 Trigger and Serial Connector

The trigger and serial connector has the following pin definition:

1	Trigger IN
2	GND
3	Serial IN
4	NC Reserved

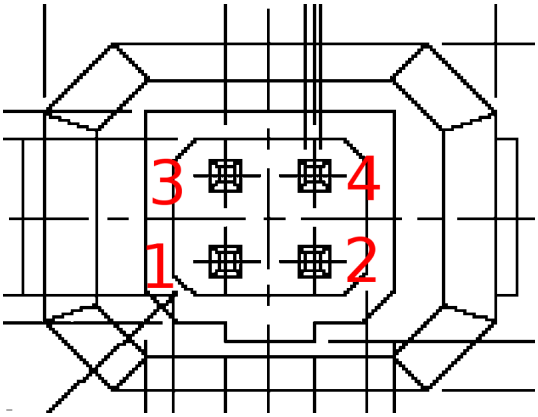


Image capture is triggered when the *Trigger IN* pin is pulled to ground. It is connected to 3.3V internally via resistor. You can apply a switch or a transistor between 1 (Trigger IN) and 2 (GND). It

is also possible to connect a digital signal (0-5V) to the trigger input.
Images are captured as long as *Trigger IN* is at ground level. It is not possible to connect the trigger input permanently to GND, because in this case there would be no way to switch ThermalCapture off or release the memory stick, without potentially damaging its file-system.

Serial IN is a UART interface. It supports inverted and not inverted signals (0-5V). The data received at this pin is continuously stored in an internal buffer. This buffer is added to any stored image. So it is possible to connect a GPS receiver or an IMU to ThermalCapture. Since the data is only stored but not processed at ThermalCapture, any UART based protocol can be used as long the sensor begins with data output on its own. Interface settings (baud rate etc.) can be done with the serial configuration tool (see chapter 2).

2 Configuration

Before ThermalCapture can be used in a specific setup, it is necessary to configure the TAU core correctly. Configuration of ThermalCapture is only needed if the serial input (see chapter 1.1.4) is used to connect to a GPS receiver or a similar device.

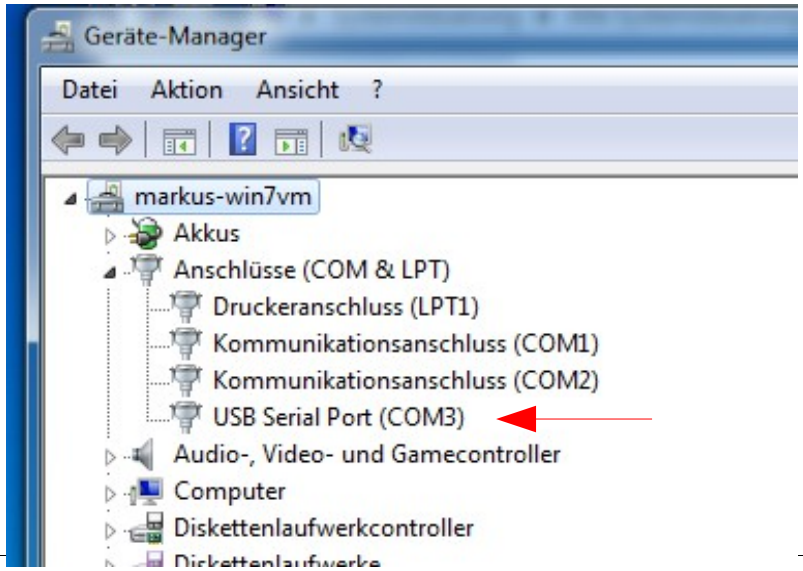
2.1 Configuration of the TAU Core

TAU core configuration is only necessary if you have mounted ThermalCapture to a TAU core on your own, or if you want to change some core related settings. If this is not the case, please proceed with chapter 2.2.

2.1.1 Driver Install

ThermalCapture uses the FTDI232RL USB serial converter IC to connect the TAU core to the Mini-USB interface. To get access to the TAU core with your PC, you may need to download and install the FTDI VCP driver from http://www.ftdichip.com/Drivers/VCP.htm .

After installation the TAU core is connected to a virtual serial interface (COMX). Please open the device manager and look which COM – interface it has got.



2.1.2. Flir Software Installation

The configuration of the Tau core is done by software from FLIR.

You need the *FLIR Camera Controller GUI for Tau and Quark:*
http://www.flir.com/cvs/cores/view/?id=51880

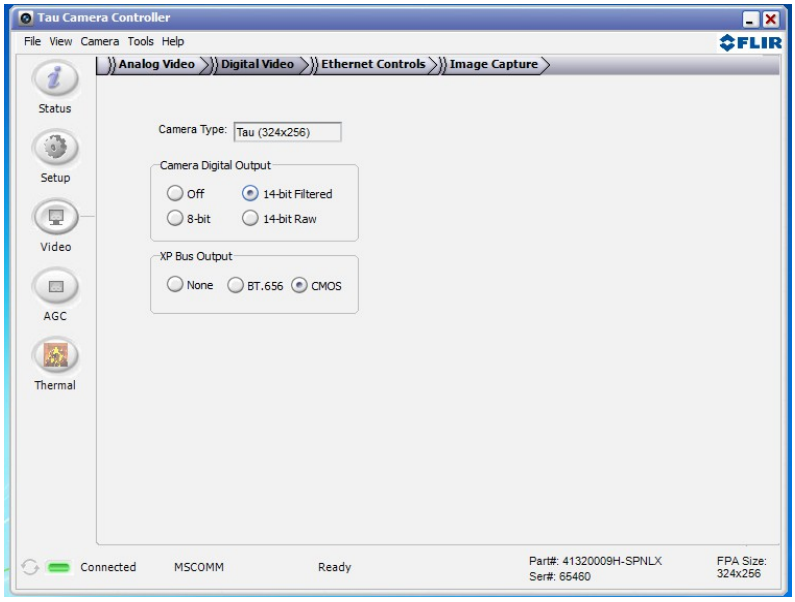
and the *FLIR GUI User Guide:*
http://www.flir.com/uploadedFiles/CVS_Americas/Cores_and_Components_NEW/Resources/GUI_UsersGuide_r100.pdf

Connect the Mini-USB interface of ThermalCapture to your PC and follow Chapter 4 of the *FLIR GUI User Guide* to connect to the camera.

2.1.3 TAU Configuration

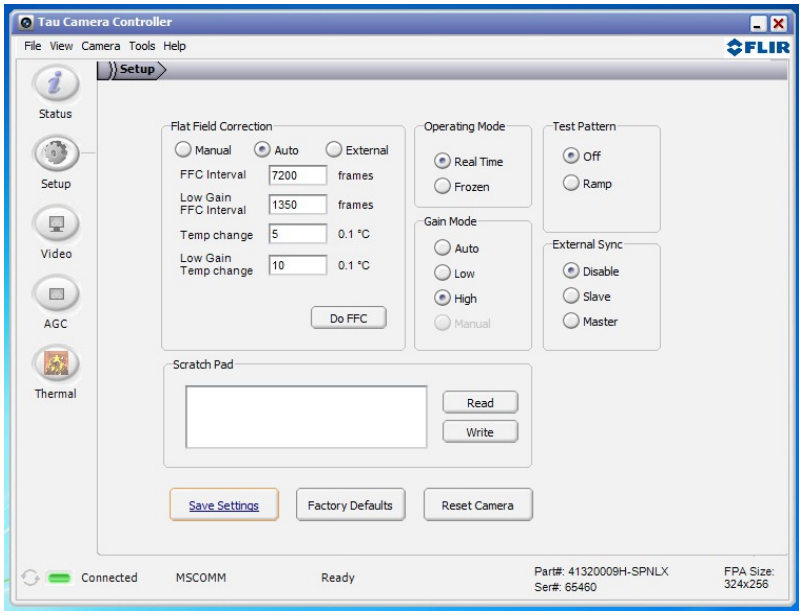
ThermalCapture gets the images from the digital output of the TAU core. This output is switched off by default. If the output is not enabled, ThermalCapture cannot record images.

The digital output must be enabled with the Flir "Camera Controller GUI".
After the FLIR GUI has connected to the TAU core, go to the *Digital Video* Tab and select *CMOS* for *XP Bus Output* and *14-bit filtered* output.



If your TAU core has the “advanced radiometry option”, TLinear should be enabled to have per pixel temperature measurement in ThermoViewer.

These settings must be saved permanently. To achieve this, go to the *Setup* tab and click to *Save Settings*.

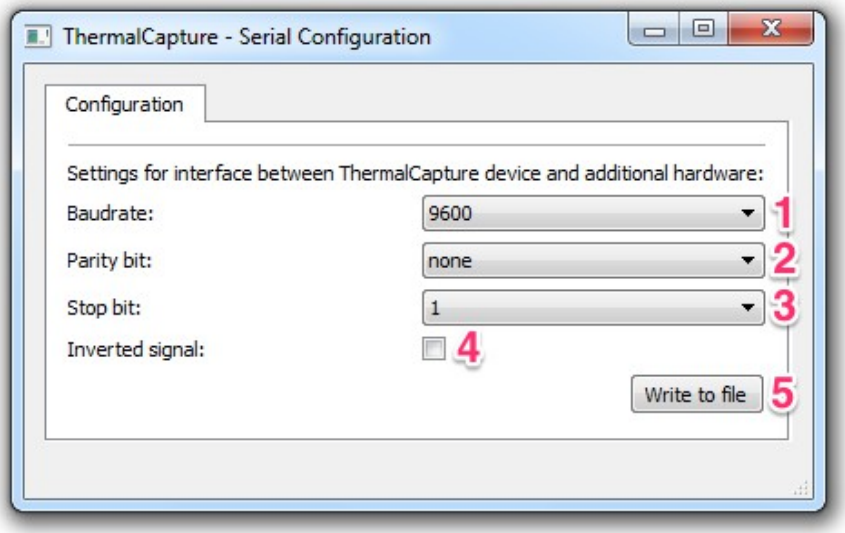


Without this, the settings will be lost with the next power cycle and recording cannot work.

Now the TAU core is ready to be used with ThermalCapture.

2.2 Configuration of ThermalCapture

If the serial input (see chapter 1.1.4) is used, it needs to be configured for a specific data source. ThermalCapture is delivered together with a configuration software to set up this serial interface. This chapter describes how to use the *TC-Configurator* software.



Settings for the serial interface are communicated to ThermalCapture by generating a configuration file and saving it onto the USB memory stick, which is used for picture

storage. This file contains information about the Baudrate (1), Parity Bit- (2), Stop Bit- (3) and Inversion-settings (4). These settings must agree with the settings of the connected hardware.

- Supported Baudrates range from 1200 to 115200
- Parity can be set to “none”, “odd”, or “even”
- 1 or 2 Stop bits
- The check box (4) determines, if inversion is active or not

The button “Write to file” opens a file dialog in which the root directory of the USB memory stick should be selected as target. The supposed filename “TCCONFIG.BIN” must be used to allow ThermalCapture to read it. The file can also be saved to a different destination and copied to the USB memory stick manually later on.

3 ThermalCapture Usage

ThermalCapture was designed to be used with UAVs. Its task is to store thermal image data from the TAU core, when the trigger signal occurs. So there is only limited human intervention necessary to operate ThermalCapture. In the following the complete process from power up through data recording to power down is described.

3.1 Power On

You can power on with or without a connected memory stick. ThermalCapture begins to boot immediately when 5V is supplied to the MINI-USB connector. During boot up the LED on the back side glows red. This will take one or two seconds. After boot up ThermalCapture waits for the USB Memory stick and the LED glows green. When the stick was found and ThermalCapture is ready to work, this LED will start blinking green.

3.2 Data Recording

When the trigger input is pulled to ground images from the TAU core are captured and stored to the USB stick. The LED on the back side will flicker red and the letters “REC” are shown in the analog video output. Do not power off ThermalCapture or release the USB stick when the red LED is flickering. The file-system of the USB stick may get damaged. If an error occurred while writing the data to the USB stick the LED will blink green and red alternately. This will even happen if the USB stick is full.

3.3 Power Off

Every time the LED does not flicker red, it is safe to remove the USB stick or to power off ThermalCapture. Power off can only be done by turning off the power supply which is connected to the MINI-USB connector.

4 Post Processing with ThermoViewer Software

ThermoViewer is the post-processing software provided by TeAx Technology to process RAW data captured with ThermalCapture. It allows the user to quickly browse through recorded data and tune every single frame into the perfect result. For further usage of the data it can be exported into images like JPG and PNG, videos and CSV data. CSV is especially useful, if further automatic data processing follows. There is also the option to export data into radiometric JPGs. Those files can be opened with powerful FLIR tools for deeper analysis, or automatic report generation.

4.1 First steps

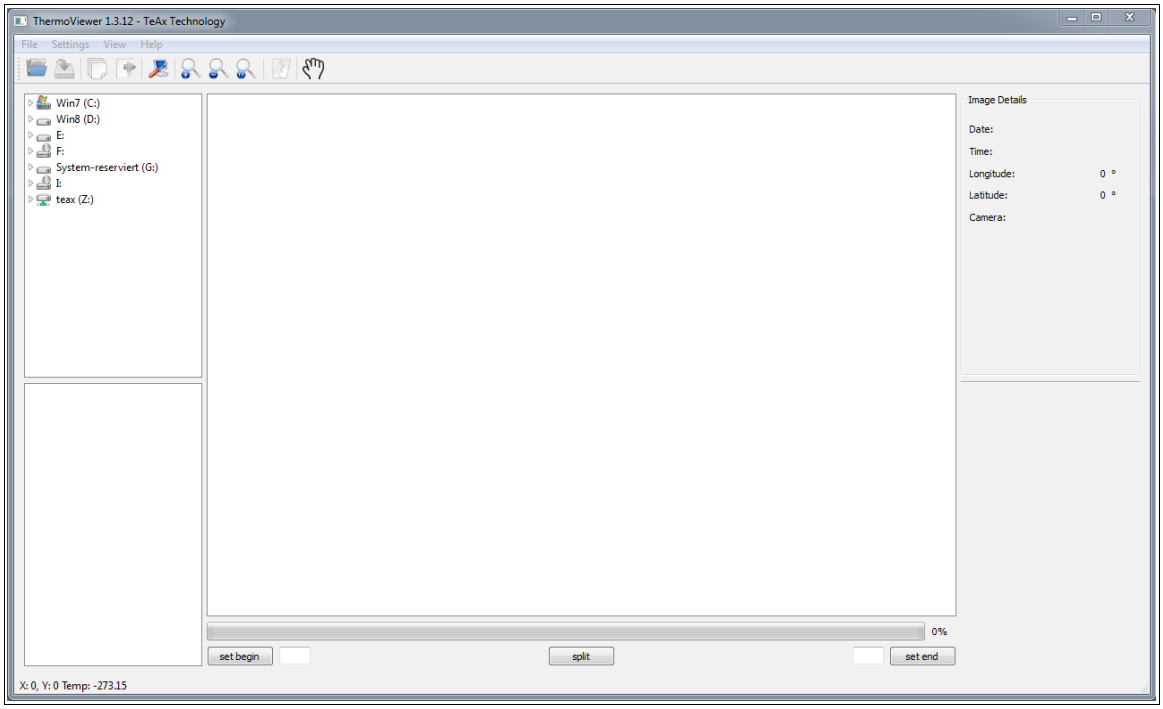


Figure 1: ThermoViewer after loading

Once you open up ThermoViewer you will see a window like shown above. On the top there are menu- and tool bar. The main window part below is split into three areas:
On the left side there are folder and file browsing areas (see 4.2.1 Open and browse files). In the middle is the canvas for images. Underneath are the video control elements (see 4.2.2 Playback). On the right side additional image properties are displayed.

4.2 File handling

TODO

4.2.1 Open and browse files

Opening files can be done in three different ways:

1. Select the folder directly in the directory tree on the left side of the window. Once you select the desired directory, the file list underneath will show all loadable files within it.
2. Use the toolbar button:
3. Use the corresponding menu item within the “File” menu.

Either way the first image is loaded and shown in the center area of ThermoViewer. All parameters needed for conversion from RAW into a user friendly representation are determined automatically, if this feature is not disabled by the user.

4.2.2 Playback

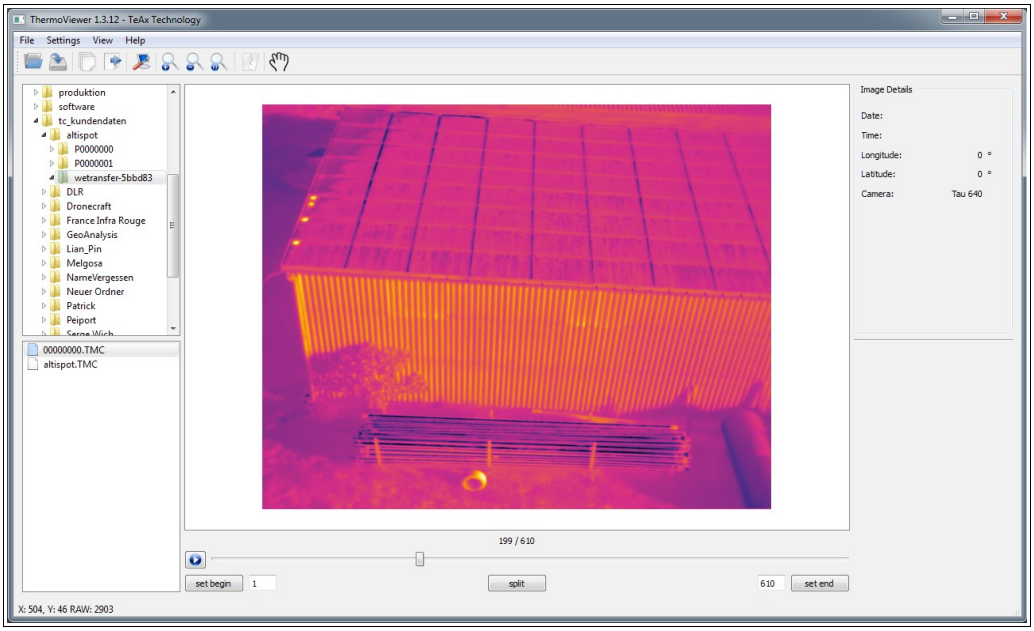


Figure 2: ThermoViewer after loading RAW data file

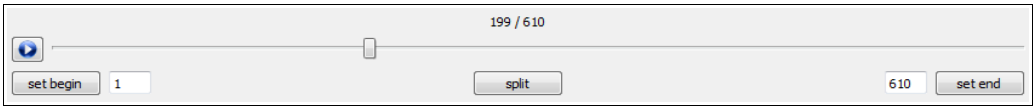


Figure 3: Video controls

A data set consists from 1 to 1000 frames, when recorded with ThermalCapture. To quickly browse through the frames, a simple slider drag, shown in Figure 3 is enough. Left to the slider there is a playback button which starts an automatic replay.

4.2.3 Zooming and dragging

To zoom in and out simply place the mouse cursor over the image and turn the mouse wheel up, or

down.
Alternatively three buttons from the toolbar can be used:

Zoom in

Zoom out

Original size

If the zoom level is high, the image may not fit into the canvas anymore. To move the currently visible part of the image, either the two scrollbars can be moved, or the mouse behavior can be changed.

Switch to drag mode

Switch to measurement mode

When in drag mode the image can be dragged around by holding down the left mouse button and moving the mouse.

4.2.4 Temperature reading

ThermalCapture stores radiometric data. That means, that for every pixel in every frame, temperature information is available. To determine the temperature of a given pixel, simply move the mouse cursor over the pixel. It is recommended to switch the mouse mode to “measurement” to be able to select pixels more accurately. The temperature value is shown together with the pixel position in the lower left corner of the ThermoViewer window.

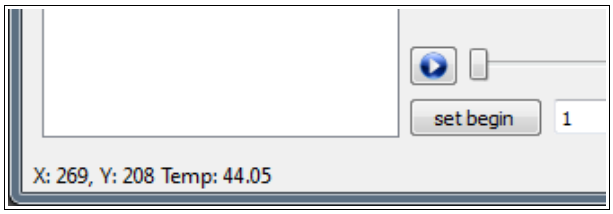


Figure 4: Temperature reading

If instead of the temperature a RAW value is displayed you need to change the “Radiometry” setting. See “XYZ” how to do this.

4.3 Adjust RAW conversion parameters

In general ThermoViewer uses a built-in algorithm to convert every recorded dataset into a good looking image. But in some cases the user wants to adjust parameters to specific needs in order to highlight details, or to fade out meaningless areas. This section describes the available tools to optimize the results.

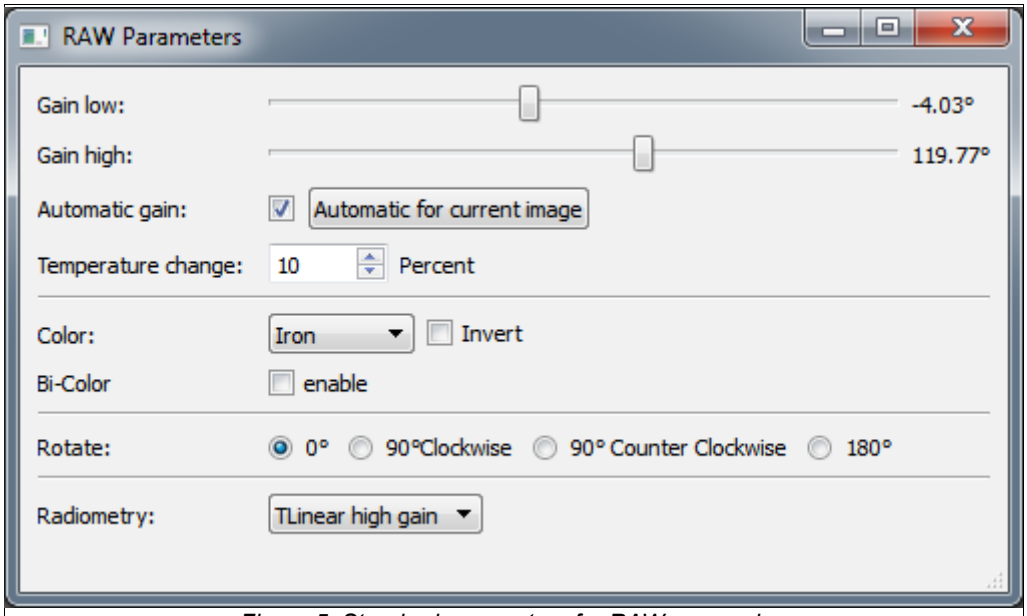


Figure 5: Standard parameters for RAW conversion

TODO!

The color drop down list (3) provides three different color schemes that can be used to transfer the RAW data into false color image. All of these three color schemes can additionally be inverted by checking the appropriate checkbox.

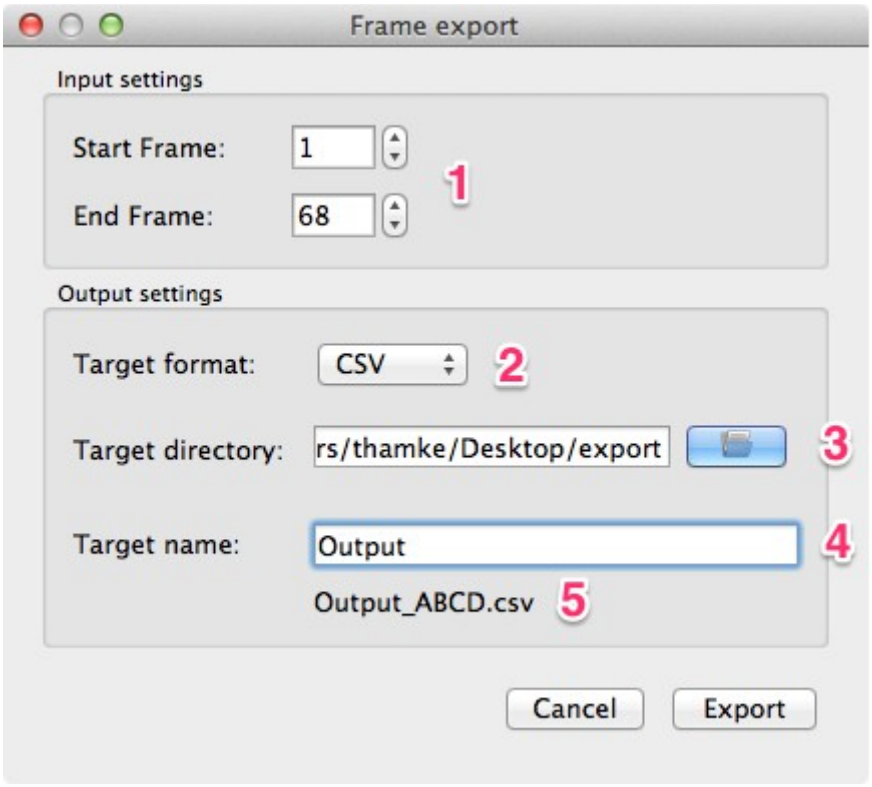
If the orientation of RAW data is wrong, it can be corrected by selecting a rotation angle (4). They are available in 90 degree steps.

The “Radiometry” drop down list is used to chose if a legend should be added to the image and if so, how the RAW data has to be interpreted. There are the options “none” for no legend, “TLinear high gain” and “TLinear low gain”. If the connected Tau core supports the advanced radiometry features, the appropriate item has to be chosen from the two TLinear options.

4.3 Export functions

You can export data to binary image formats like PNG and JPG and from version 1.3.2 on, also into comma separated value files (CSV).

To open the export dialog press the 4th item from the left within the toolbar, or select the item “Export frames” from the file menu.



In the “Frame export” dialog the user can set all necessary option for the export of single or multiple frames. The first step is to select frames, which should be exported. The values in the input fields (1) are taken from the main window input fields, but can be adjusted here if needed.
The target format can be selected by the drop down menu (2). Available formats are PNG, JPG and CSV. PNG images are stored lossless, which means that no compression errors appear in the final image. JPG uses non-lossless compression, but delivers far smaller data sizes. CSV writes the temperature values into a comma separated value file, which can be used in any application which can open these files, like Microsoft Excel, or Matlab.
The target directory into which the output files will be written can be entered manually into the text field (3), or can comfortable be selected by opening a file browsing window using the button.
The target name consists of three parts. The first part can be entered by the user into the textfield (4). ThermoViewer will automatically add a continuous number to this name and also the extension selected in (2).

4.4 NMEA Parser

If you connect a GPS receiver to the serial interface of ThermalCapture and the device is set up to send NMEA data, then you are able to activate the “Parse NMEA Data” option in Settings menu. Extracted data from the GPRMC messages is then shown on the right side of ThermalViewer main window.